CHAPTER 5, WATER SUPPLY ASHORE
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Section 1. GENERAL INFORMATION

5-1 PURPOSE

This chapter provides public health and preventive medicine information and guidance for Department of the Navy personnel and others concerned with potable water supply at shore facilities.

5-2 BACKGROUND

a. The Safe Drinking Water Act, a Public Law, (SDWA) was signed into law on 16 December 1974. The SDWA and later amendments directed the U.S. Environmental Protection Agency (EPA) to develop federally enforceable National Primary Drinking Water Regulations (NPDWR) for all public water supply systems. As a result of this legislation, primary enforcement authority (primacy) is to be adopted by the individual states.

b. Under the SDWA, EPA has developed National Secondary Drinking Water Regulations (NSDWR) for all public systems. Contaminants covered by NSDWR concern the aesthetic quality of drinking water. Unlike the NPDWR, the NSDWR are not federally enforceable; but may be incorporated into state law and enforced by the respective state.

c. Regulations for drinking water purchased or produced at Navy and Marine Corps activities in foreign countries are included in environmental documents published by the Department of Defense (DoD). These DoD regulations do not apply to operational and training deployments off-base, U.S. Naval vessels, and U.S. military aircraft which will be operated in accordance with other DoD policies, directives, and applicable international agreements.

(1) DoD *Environmental Final Governing Standards*, if completed with the Country where the facility is located, apply.

(2) If the *DoD Environmental Final Governing Standards* have not been completed (published) for the country where the

facility is located, drinking water regulations in the DoD *Overseas Environmental Baseline Guidance Document* are used. The *DoD Overseas Environmental Baseline Guidance Document* also includes specific DoD environmental criteria to be used by Executive Agents in developing the "*final governing standards*" in the host nations concerned.

5-3 POLICY

a. The NPDWR are published in Title 40, Code of Federal Regulations (CFR 141); NSDWR are published as 40 CFR 143. OPNAV Instruction 5090.1 Series, Environmental and Natural Resources Program Manual, publishes procedures implementing the SDWA and 40 CFR 141 and 143 within the Department of the Navy.

b. BUMED Instruction 6240.10 Series, Standards for Potable Water, sets drinking water standards for Naval establishments ashore (United States and territories) and afloat.

5-4 RESPONSIBILITIES

a. Navy Facilities Engineering Command (NAVFACENGCOM):

(1) Provides technical assistance, including requirements for cross connection control, to major claimants and activities.

(2) Maintains management information, including a current inventory of Navy public water systems and any violation of safe drinking water standards.

(3) Develops and distributes technical advice and appropriate manuals or other forms of guidance for implementing water conservation within the Navy.

(4) Provides assistance to shore activities for testing of drinking water outlets and selecting lead mitigation methods.

b. Chief, Bureau of Medicine and Surgery:

(1) Revises instructions and other appropriate documents to reflect Navy requirements.

(2) Establishes and publishes appropriate additional standards of water quality and monitoring requirements for Navy drinking water systems afloat and overseas.

(3) Provides health-related advice to Navy commands in carrying out their responsibilities for drinking water quality and distribution.

(4) Ensures that health and safety issues are addressed when chemical additives are used in drinking water, especially chemical additions used to reduce lead.

c. Major claimants:

(1) Implement the SDWA program requirements at their shore activities.

(2) Plan, program, budget and provide funding for current and future requirements under the SDWA and revisions to the NPDWR.

d. Commanding officers of shore activities:

(1) Budget sufficient resources for operations maintenance, and repair of drinking water systems in compliance with applicable standards, including sampling/monitoring, reporting, recording, and other substantive and administrative requirements, including Navy requirements.

(2) Ensure, if commanding officer of host activity that owns, operates or uses drinking water systems, applications for applicable federal, state and/or local permits are filed and that activity(ies) comply with EPA, state, and local drinking water requirements.

(3) Review the various uses of water at their activities to ensure that all economically practical water conservation measures are taken.

(4) Provide for proper sampling and analysis, monitoring, operation, maintenance, repair and alteration regarding the drinking water system.

(5) Ensure all personnel who collect samples and perform potable water system analysis are certified to do so per applicable federal, state, and local regulations.

(6) Provide resources (tuition, travel, per diem) for training operators of public water systems and ensure compliance with applicable state certification requirements.

(7) Identify and submit compliance projects per Chapter 1, OPNAVINST 5090.1 Series or Marine Corps Order P5090.2A, Chapter 3.

(8) Ensure that plumbing repairs made to activity drinking water systems use lead free materials.

(9) Ensure that an adequate number of facility locations are included in the primary supplier's lead and copper sampling pool, and that appropriate action is taken, either by the primary supplier or the facility.

(10) Perform lead and copper monitoring, when the Navy water supplies are not included in the primary supplier's sampling pool.

(11) Conduct vulnerability assessments and sanitary surveys as needed.

(12) Ensure that an operation and maintenance program is established and implemented at each activity. This applies to both primary and consecutive water supplies. At a minimum, the program must ensure proper emergency and preventive maintenance, proper system disinfection after maintenance work is performed, scheduled flushing of the distribution system as needed, and a valve exercise and maintenance program.

(13) Ensure that a Cross-Connection and Backflow Prevention Program is established and implemented at each activity.

e. Preventive Medicine Authority: The installation preventive medicine authority has an advisory role and recommends corrective measures when any phase of water sanitation is unsatisfactory.

Section II. IMPORTANCE OF POTABLE WATER

5-5 GENERAL

a. Most community water suppliers deliver high quality drinking water to millions of Americans every day. Of the more than 55,000 Community Water Systems in the United States, only 4,769 or 8.6 percent reported a violation of one or more drinking water health standard in 1996.

b. Nationwide, drinking water systems have spent hundreds of billions of dollars to build drinking water treatment and distribution systems, and they spend an additional $22 billion per year to operate and maintain them. Additional funds became available in 1997 to upgrade drinking water systems and implement local source water protection activities.

c. In addition, there is a network of government agencies empowered to ensure that public water supplies are safe. Nonetheless, problems with local drinking water can, and do, occur.

5-6 CONTAMINANTS IN DRINKING WATER

a. All sources of drinking water contain some naturally occurring contaminants. Because water is the universal solvent, many materials are easily dissolved upon contact. At low levels, these contaminants generally are not harmful in our drinking water. Removing all contaminants would be extremely expensive and in nearly all cases would not provide greater protection of health. A few of the naturally occurring substances may actually improve the taste of drinking water and may have nutritional values at low levels.

b. As population growth and development of natural areas increase, there are growing numbers of contamination threats to drinking water. Suburban sprawl has encroached upon watersheds, bringing with it potentially hazardous by-products. Instances of serious drinking water contamination occur infrequently, and typically not at levels posing near-term health concern. Nonetheless, with the threats of such events increasing, drinking water safety cannot be taken for granted.

5-7 MICROBIOLOGICAL, PHYSICAL, AND CHEMICAL CONTAMINANTS

a. Microbiological and chemical contaminants can enter water supplies. These materials can be the result of human activity or can be found in nature. For instance, chemicals can migrate from disposal sites and contaminate sources of drinking water. Animal wastes and pesticides may be carried to lakes and streams by rainfall runoff or snow melt. Human wastes may be discharged to receiving waters that ultimately flow to water bodies used for drinking water. Coliform bacteria from human and animal wastes may be found in drinking water if the water is not properly treated or disinfected. Coliform bacteria are also used as indicators that other harmful organisms may be in the water.

b. The potential for health problems from drinking water is illustrated by localized outbreaks of water-borne disease. Many of these outbreaks have been linked to contamination by bacteria or viruses, probably from human or animal waste. In 1993 and 1994, for example, there were 30 reported disease outbreaks associated with drinking water, 23 associated with public drinking water supplies and 7 with private wells.

c. Certain pathogens, such as *Cryptosporidium*, may pass through water treatment filtration and disinfection processes in sufficient numbers to cause health problems. *Cryptosporidium* is a protozooan that causes the gastrointestinal disease cryptosporidiosis. The most serious and sometimes deadly, consequences of cryptosporidiosis tend to be focused among sensitive members of the population such as individuals with immune system deficiencies.

d. Nitrate in drinking water at levels above the national standard poses an immediate threat to young children. Excessive levels can result in a condition known as “blue baby syndrome.” If untreated, the condition could be fatal.

5-8 RADIOLOGICAL CONTAMINANTS

Naturally occurring contaminants also are being found in drinking water. For example, the radioactive gas radon-222 occurs in certain types of rock and can get into ground water. People can be exposed to radon in water by drinking it, while showering, or when washing dishes. The primary source of exposure to radon in the home is radon seeping out of the soil and into the basement air.

Section III WATER SOURCES

5-9 GENERAL

a. Drinking water comes from surface water and ground water. Large-scale water supply systems tend to rely on surface water resources, and smaller water systems tend to use ground water. Including the approximately 23 million Americans who use ground water as a private drinking water source, slightly more than half of the population receives its drinking water from ground water sources.

b. Surface water includes rivers, lakes, and reservoirs. Ground water is pumped from wells that are drilled into aquifers. Aquifers are geologic formations that contain water. The quantity of water in an aquifer and the water produced by a well depend on the nature of the rock, sand, or soil in the aquifer where the well withdraws water. Drinking water wells may be shallow (50 feet or less) or deep (more than 1,000 feet). The water utility or public works department can identify the source of the public drinking water supply.

5-10 PUBLIC WATER SYSTEM

a. The SDWA defines a public water system as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days per year. Such systems may be owned by homeowner associations, investor-owned water companies, local governments, and others. Water that does not come from a public water supply, and which serves one or only a few homes, is called a private supply.

b. Community water systems are public systems that serve people year-round in their homes. EPA also regulates other kinds of public water systems-such as those at schools, factories, campgrounds, or restaurants that have their own water supply. The information in this chapter covers only community water systems because they are the source of most drinking water.

c. Many installations have isolated water sources, such as wells and springs, for drinking water in training areas. In many cases, these isolated water sources do not serve 25 individuals daily for 60 days a year and have less than fifteen service connections; therefore, they are not classified as public water systems. These sources are considered field sources. Sanitary control of field sources is addressed in Chapter 9 of this manual, Preventive Medicine for Ground Forces.

d. Further information on water systems is located in section 5-31.

5-11 BOTTLED WATER

a. Bottled water may be used on Navy and Marine Corps installations in the United States or overseas as a source of drinking water. Bottled water is derived from surface or subsurface water sources, depending on the bottler, and has been shown to be of variable quality. It is commonly contended that bottled water may be of better quality than locally available public water supplies. This may not be the case. Bottled water will be only as good as the source from which obtained and the quality of treatment received. Bottled water used at Navy and Marine Corps installations must meet all the quality requirements of (Title 21 Code of Federal Regulations Part 103.35 (21 CFR 103.35) and be processed and bottled in plants meeting the standards in 21 CFR 129).

b. Approved bottled water sources may be found in the U.S. Army publication, "*Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement*" or NSF Listings for "*Bottled Water and Packaged Ice*."

Section IV WATER DISTRIBUTION SYSTEMS

5-12 GENERAL

The use of substandard facilities for water distribution will adversely affect the quality of the water. The safety and palatability of the water must not be impaired by defects in the system. The distribution system must not leak and, when possible, its various mains and branches will not be submerged in surface water or ground water. Dead-end mains must be reduced to ensure effective circulation of the water. Water mains must be laid above the elevation of sanitary sewers and at least ten feet horizontally from such sanitary sewers when they are parallel. Where a sanitary sewer crosses over a water supply pipe, the sanitary sewer must be in pressure pipe or encased in concrete for ten feet on both sides.

5-13 CROSS-CONNECTIONS

Interconnections between a potable water distribution system and a non-potable system must not be permitted. Each potable water distribution system must be periodically inspected to detect and remove all potential or existing cross-connections and to ensure that proper engineering measures, e.g., air gaps and back-flow prevention devices, are in place and properly operating. Only through routine inspections can the control and elimination of hazards be achieved. EPA-570/9-89-007, *Cross-connection Control Manual*, gives excellent information on methods and devices for backflow prevention, testing procedures for backflow prevention devices, and administration of a cross-connection control program. NAVFACINST 11330.11 series contains a list of backflow prevention devices approved for use at Navy and Marine Corps shore installations. See Appendix B for definitions of terms used in this chapter.

5-14 WATER MAIN FLUSHING AND DISINFECTION

a. Public works or maintenance personnel must make sure that new or repaired mains and extensions are cleaned and flushed with potable water prior to disinfecting and placing into service. The purpose of this flushing is to clear all dirt, mud, and debris from the new or repaired mains. A velocity of at least three feet per second is needed for adequate flushing.

b. Disinfecting Water Mains.

(1) When the number of gallons of water the component

or system contains or will contain has been determined, the correct dosage of calcium hypochlorite (65-70% free available chlorine (FAC)) or sodium hypochlorite (five to ten percent FAC) may be found by referring to the "Chlorine Dosage Calculator" in Chapter 6, Water Supply Afloat, of this manual. This calculator gives the approximate dosage of chemicals needed for the desired disinfecting FAC residual. These residuals must be checked with the DPD color comparator procedure or an electronic chlorine residual testing device.

(2) When portable gas chlorinators are used to disinfect mains, tanks, or other units, the operator's instruction manual must be consulted. The desired disinfecting residuals must be checked.

(3) Residuals and specified contact times listed in Table 5-1, are acceptable for disinfecting water mains, tanks, and other appurtenances providing they are first cleaned and flushed, as above, with potable water.

Table 5-1. Water main disinfecting procedures.

Initial FAC ppm	Contact Time	FAC ppm After Required Contact Time
50 ppm	24 hours	25 ppm
500 ppm	30 minutes	500 ppm
100 ppm	4 hours	50 ppm

(4) Swabbing Repair Pipe Length and Fittings. Besides the flushing and disinfecting procedures described above, the interior of all repair pipe lengths and fittings must be swabbed with five percent chlorine solution (50,000 PPM) before installing. After the repairs are completed, the repaired section must be flushed and disinfected as discussed above. The purpose of swabbing is to make sure that the residue in the joints and fittings is oxidized.

(5) Post Disinfection, flushing, and Microbiological Analysis. Regardless of the method used to disinfect new or repaired mains, the high concentration chlorine solutions must be flushed from the line after disinfection is complete. Samples must then be collected down flow from the affected pipe length, or on both sides of the length if the direction of flow is variable or unknown. Samples must be checked for

microbiological contamination to make sure that disinfection has been adequate.

5-15 PRESSURE

Water distribution systems must be designed to provide an acceptable operating pressure. Areas on high ground or with high pressure demand must have a separate high service system for maintaining pressure by pumping, backed by elevated storage, whenever possible. No main in a Navy and Marine Corps distribution system should be less than six inches in diameter. Sizes 4 inches and smaller are to be used only upon the approval of NAVFAC Headquarters.

5-16 USE OF NON-POTABLE WATER

Non-potable distribution systems must be designed to prevent interconnection, e.g., by use of incompatible coupling devices, with the potable water system. The Marking "NON-POTABLE" must be stenciled on the non-potable distribution system. On shore stations, color-coding of pipes will be used to distinguish potable from non-potable systems. See Table 5-2.

Section V POTABLE WATER STORAGE

5-17 GENERAL

Potable water distribution reservoirs are necessary for fire fighting, to satisfy peak demands, to support uniform water pressure, to meet industrial demands, and to avoid continuous pumping. MIL HDBK 1005/7 gives detailed information on selection of storage tanks for use on Navy and Marine Corps installations.

5-18 MAINTENANCE

a. Inspection, maintenance, and repair of storage tanks is essential. Corrosion and scaling in storage tanks may adversely affect the quality of the stored water, and ultimately result in their structural failure. All tank coatings, including sealing compounds and other materials must be equivalent to or qualified to National Sanitation Foundation International (NSF) Standard No. 61. Non-potable systems must be physically separated from all potable water distribution systems. Only authorized personnel can operate the non-potable system.

b. Non-potable fresh or salt water is used for fire protection, flushing, and industrial uses only when the potable water supply is insufficient for all requirements.

c. The use of non-potable water for personal hygiene, e.g., laundering, showering, and bathing, is prohibited for Navy and Marine Corps installations.

TABLE 5-2. Color coding for shore-to-ship water connections

Water Type	Color
Potable Water	Blue, dark
Water provided for Fire Protection	Red
Chilled Water	Striped Blue and White
Oily Waste-Water	Striped Yellow and Black
Sewer	Gold

5-19 SANITARY STANDARDS FOR WATER STORAGE

a. When potable water tanks are below ground level:

(1) The overflows, e.g., manhole covers and vents, must be located with their tops six inches above grade.

(2) The bottom of the tank must be higher than the water table or flood water; designed for a minimum of eight feet.

(3) The ground around the tank must be sloped away from the tank to provide drainage.

(4) The tanks must be located at a level which is higher than any sewers or sewage systems.

(5) Sewers or sewage disposal systems must be located at least 50 feet from water storage tanks.

b. All Potable Water Tanks.

(1) Potable water storage tanks must be covered to prevent contamination by dust, rain, insects, animals, birds, and to discourage algae growth.

(2) All vents and overflows must be screened with 20-mesh bronze insect screens. The vents must be rainproof by using goose-necks or vent caps.

(3) The construction and location of manholes must minimize the possibility of contamination. Manholes (roof hatch) should be designed with a coaming or curb two to six inches high around the opening. The manhole covers must overlap this coating by at least two inches. Except when in actual use, manhole covers should be locked.

(4) Overflow and drain pipes must not be directly connected to sewers.

c. Safety precautions must be taken before entering the storage tank to prevent accidents due to oxygen deficient atmospheres or harmful concentrations of toxic or explosive gases or vapors. The NAVSEA Gas Free Engineering Manual (NAVSEA S6470-AA-SAF-010), American National Standards Institute (ANSI) Z117.1-1995, Safety Requirements for Confined Spaces, and local instructions must be consulted for correct entry procedures. The local safety and health officer or an industrial hygienist (available at Naval Hospitals, clinics, and NAVENPVNTMEDUs) should be contacted for safety information on working in tanks and other confined spaces.

(1) Ladders with approved safety cages must be used on all standpipes and elevated storage tanks.

(2) Install a wire fence and locked gate around storage tanks to prevent unauthorized entrance.

5-20 DISINFECTION OF WATER STORAGE TANKS

a. Potable water tanks must be disinfected before put into service or when entered for inspection or any other reason. Tanks must also be disinfected when bacteriological evidence shows that the tank has become contaminated.

b. Disinfecting procedures may be one of the techniques described in Article 5-26 or a method which uses spraying or swabbing the walls and surfaces with a 500 ppm FAC solution. This concentration gives almost immediate disinfection. After complete application, all surfaces must be flushed with potable water. This operation must be coordinated with facility medical personnel and entry and work must follow 5-19.c above.

Section VI WATER TREATMENT

5-21 GENERAL

Water suppliers use a variety of treatment processes to remove contaminants from drinking water. These individual processes may be arranged in a “treatment train” to remove undesirable contaminants from the water. The most commonly used processes include flocculation, sedimentation, filtration and disinfection. Some treatment trains also include ion exchange and adsorption. A typical water treatment plant would have only the combination of processes needed to treat the contaminants in the source water used by the facility. MIL HDBK 1005/7 gives further information on the specifics of various treatment methods.

5-22 FLOCCULATION/SEDIMENTATION

Flocculation refers to water treatment processes that combine small particles into larger particles, which settle out of the water as sediment. Alum and iron salts or synthetic organic polymers (alone, or in combination with metal salts) are generally used to promote coagulation. Settling or sedimentation is simply a gravity process that removes flocculated particles from the water.

5-23 FILTRATION

Many water treatment facilities use filtration to remove remaining particles from the water supply. Those particles include clays and silts, natural organic matter, precipitants from other treatment processes in the facility, iron and manganese, and microorganisms. Filtration clarifies water and enhances the effectiveness of disinfection.

5-24 ION EXCHANGE

Ion exchange processes are used to remove inorganic constituents if they cannot be removed adequately by filtration or sedimentation. Ion exchange can be used to treat hard water. It can also be used to remove arsenic, chromium, excess fluoride, nitrates, radium, and uranium.

5-25 ADSORPTION

Organic contaminants, color, and taste-and odor-causing compounds can stick to the surface of granular or powdered activated carbon (GAC or PAC). GAC is generally more effective than PAC in removing these contaminants. Adsorption is not commonly used in public water supplies.

5-26 DISINFECTION (CHLORINATION, OZONATION)

a. Water is disinfected before it enters the distribution system to ensure that dangerous microbes are killed. Chlorine, chloramines, or chlorine dioxide most often are used because they are very effective disinfectants, and residual concentrations can be maintained to guard against biological contamination in the water distribution system. Ozone is a powerful disinfectant, but it is not effective in controlling biological contaminants in the distribution pipes because it leaves no disinfectant residual.

b. EPA is in the process of developing regulations limiting the amount of disinfection by-products (DBPs). DBPs are contaminants that form when disinfectants react with organic matter that is in treated drinking water. Long-term exposure to some DBPs may increase the risk of cancer or other adverse health effects.

c. **Chlorination.**

(1) Under normal operating conditions, chlorination is the most widely used procedure for the routine disinfection of water. The efficiency of chlorine is affected by the following variables:

(a) The types and concentrations of the chlorine forms present.

(b) The pH of the water. At pH 6.5 and a temperature of 70^{o} F (22^{o} C), 0.3 ppm of combined residual causes a 100 percent bacterial kill in 60 minutes. With the same temperature and time, at pH 7.0 the combined residual must be increased to 0.6 ppm to accomplish the same degree of bacterial kill. Data for this pH-chlorine residual relationship are presented in Table 5-3.

TABLE 5-3. Chlorine-pH relationship for 100% bacterial kill in 60 minutes (at 72^{o}F)

pH	COMBINED CHLORINE (ppm)
6.5	0.3
7.0	0.6
7.7	0.9
8.0	1.0
8.5	1.2
9.5	1.5
10.5	1.8

(c) The type and density of organisms (virus, bacteria, protozoan, helminth, or others). Of all the waterborne diseases, those caused by bacteria are the most easily prevented by chlorine disinfection. At the other extreme, certain pathogenic organisms such as the cysts of the protozoa *E. histolytica* and *Giardia lamblia* are very resistant. The oocysts of *Cryptosporidium parvum* are even more resistant to chlorine.

(2) Disinfection Requirements (Non-Filtering

Systems). Public water systems that do not provide filtration and use a surface water source or a ground water source under the direct influence of surface water must provide disinfection sufficient to ensure at least 99.9 percent (3 log) inactivation of *Giardia lamblia* cysts and 99.99 percent (4 log) inactivation of viruses every day the system serves water to the public, except any one day each month.

(a) The disinfectant system must have either redundant components, including an auxiliary power supply with an automatic start-up and alarm to ensure that disinfectant application is maintained continuously while water is being delivered to the distribution system, or an automatic shut-off of delivery water whenever there is less than 0.2 ppm of residual disinfectant concentration in the water. See 40 CFR 141.72(a)(3) for an exception to the water shut-off device.

(b) The residual disinfectant concentration entering the distribution system cannot be less than 0.2 ppm for more than four hours. The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be less than 0.2 ppm for more than four hours.

(c) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be undetectable in more than five percent of the samples each month, for any two consecutive months that the system serves water to the public. See 40 CFR 141.72(4)(i) for an exception when the use of a heterotrophic plate count, approved by the state, may be used rather than a detectable disinfectant residual for purposes of determining compliance with this requirement.

d. Disinfection Requirements (Filtering Systems). Public water systems that provide filtration must provide disinfection sufficient to ensure at least 99.9 percent (3 log) inactivation of *Giardia lamblia* cysts and 99.99 percent (4 log) inactivation and/or removal of viruses as determined by the state.

(1) The residual disinfectant concentration entering the distribution system cannot be less than 0.2 ppm for more than four hours.

(2) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be undetectable in more

than five percent of the samples each month, for any two consecutive months that the system serves water to the public. See 40 CFR 141.74(a)(3i) for an exception when the use of a heterotrophic plate count, approved by the state, may be used rather than a detectable disinfectant residual for purposes of determining compliance with this requirement.

e. Chlorine Residual. Water supplied to an installation from an outside public water system should have a measurable chlorine residual (total chlorine, combined chlorine, or chlorine dioxide) in 95 percent of the samples. If not, then this should be considered in the microbiological monitoring program of the installation medical authority. Coordination between the supplier, the public works or the facilities maintenance officer and the preventive medicine authority is essential in this situation. Installation of a chlorination system for the supplied water (rechlorination) must be considered if an unhealthful situation exists. Not all disinfectants or chemicals added to purchased water will be compatible with chemicals used by the supplier. For example, the addition of chlorine sufficient to produce a FAC residual to water disinfected with combined chlorine (chloramine), which delays formation of trihalomethanes (THM), may result in a product which exceeds the maximum contaminate level (MCL) for THM. Hence, the supplier and state or EPA authorities must approve chemicals added to purchased water. Rechlorination (or other chemical addition) of purchased water could make the installation commander a new supplier of water responsible for all requirements of the SDWA implemented by NPDWR. Final interpretation of whether or not an installation is classified as a supplier of water rests with the state regulatory authorities (if primacy has been granted) or with the regional EPA officials (if in a non-primacy state or territory).

(1) Chlorination in the Event of System Problems. Water in systems where sanitary, physical, or operating defects or other special hazards are known to exist, or where microbiological examinations show that satisfactory quality cannot be obtained without rechlorination, the water should be rechlorinated to levels shown in Table 5-4.

(2) Health Effects of Chlorination. Concern has been generated over the health effects of chlorinated organics. Specifically, trihalomethanes (THMs) were placed into the MCLs of NPDWR. THMs are commonly found in chlorinated drinking water, particularly in drinking water obtained from surface sources. THMs are formed by the reaction of naturally occurring

organic substances and chlorine during drinking water treatment and distribution. Chlorination methods used by the installation water works may have a dramatic effect on the resultant level of THMs. Installations obtaining their raw water from surface sources and practicing pre- and postchlorination may practice chlorination optimization. Prechlorination dosages can be reduced to the lowest level consistent with the maintenance of a trace chlorine residual throughout the treatment system before postchlorination. Post chlorination will then be used to achieve needed chlorine residuals in the distribution system. Use of this technique allows for the most effective use of chlorine consistent with minimizing THM formation. Potable water transferred from shore to ship will normally contain at least 0.2 ppm FAC; however, ships, in some areas, may be supplied with water disinfected with chloramine. In this case, the area NAVENPVNTMEDU may be contacted for instructions on testing, treatment, and surveillance procedures.

(3) Determination of Chlorine Residuals. Both FAC and combined chlorine residuals are applicable at facilities located in the United States and overseas. Residual FAC can be determined by using the diethyl-p-phenylene,diamine (DPD) method or other EPA approved method that measures specifically for FAC. Combined chlorine residuals can be found by tests that give the total chlorine present from which the free component can be subtracted.

(4) Chlorination Methods.

(a) Marginal Chlorination. In marginal chlorination, the initial chlorine demand has been satisfied but some oxidizable substances remain.

(b) Superchlorination-Dechlorination. This procedure involves the application of chlorine in greater concentrations than are needed to afford acceptable bactericidal efficiency. This practice gives control over taste and odor producing substances as well as control of bacteria. Surplus chlorine is removed by dechlorination with sulfur dioxide, aeration, or activated carbon before the water enters the distribution system.

(c) Break-point Chlorination. In break-point chlorination enough chlorine is applied to produce a chlorine residual composed of predominantly FAC with little or no combined chlorine.

(d) Chloramines (Combined Chlorine and Ammonia). Depending on the population served, EPA has established the MCL for trihalomethanes at 0.10 ppm (0.10 mg/L). Some raw water sources contain naturally occurring substances (precursors) which react with chlorine to form THM. When chloramines, rather than free chlorine are used to disinfect water containing precursors, the formation of THM may be delayed until the water is used.

TABLE 5-4. Minimum free and combined chlorine residual, recommended in the event of water system problems

pH value	Minimum concentration of free chlorine residual after 10 minutes, ppm (mg/L)	Minimum concentration of combined chlorine residual after 60 minutes ppm (mg/L)
6.0	0.2	1.0
7.0	0.2	1.5
8.0	0.4	1.8
9.0	0.8	Not applicable
10.0	0.8	Not applicable

When compared to free available chlorine, the disinfection capabilities of chloramines are less effective. A longer contact time is needed to obtain complete disinfection. Specific chloramine disinfection techniques, e.g., ratio of ammonia and chlorine, point in treatment where chlorine is added, and point where ammonia is added, are designed for the water being treated. All proposed treatment processes to remove/prevent THM, must be approved by the state or EPA regional office.

(5) Water plant surveillance personnel must ensure that chlorine levels are maintained by regular and frequent chlorine analysis, both at the point of application and at various points in the water distribution system. Testing of treated water for chlorine residual before and after distribution must be accomplished as required by 40 CFR 141.72. Also, the installation medical authority must test for chlorine residuals when medical surveillance samples are taken. See Appendix A.

f. Other Disinfection Methods. Methods of disinfection other than chlorination are being used in the United States and throughout the world. Requests for Navy and Marine Corps to use a method other than chlorination must be granted by the applicable state where the system is located. See 40 CFR 141.72.

5-27 FLOURIDATION

Fluorides are a small but important element in the human diet. Part of the concentration may be obtained in food, but the greatest portion will come from the potable water supply. When optimum amounts of fluorides are not naturally present in drinking water, the application of fluoride to water supplies is necessary for the prevention of caries for persons of all ages.

5-28 CORROSION CONTROL

Corrosion is a phenomenon associated with a metal and the water within a distribution system. Physical factors that affect corrosion and corrosion control are temperature, velocity of water moving over the metal, changes in direction and velocity of flow, and contact with a second metal or nonmetal. Simplified indices have been developed (see *Standard Methods for the Examination of Water and Wastewater)* for determining the relative corrosiveness of the water which take into account pH, temperature, alkalinity, hardness, and total dissolved solids of the water.

Section VII WATER QUALITY STANDARDS

5-29 TREATED WATER STANDARDS

a. General. Water made available for human consumption must be of the highest quality. Quality standards for treated water reflect the maximum values of various constituents that may be present in drinking water. These values were developed by the Environmental Protection Agency (EPA) and are referred to as maximum contaminant limits (MCLs) and action levels (ALs) in the case of lead and copper. These standards are presented in Appendix E.

b. Physical Quality. The principal physical characteristics of water are color, odor, and turbidity. Temperature may also be considered a physical quality. The basis for physical quality standards is primarily related to consumer acceptance of the water. Waters having physical characteristics exceeding the limits in appendix F will not, as a general rule, be used for drinking. When water of a lesser physical quality is used due to local conditions, concurrence must be obtained from the local installation medical authority. **Note**: If water quality does not meet the standards of NPDWR (Appendix E), coordination with regulatory authorities is also required.

c. Chemical Quality. The chemical quality of water is determined by all the chemical constituents present and interactions between these constituents. The chemical quality of the water may be described in terms of inclusive characteristics, e.g., total hardness, alkalinity, and pH or it may be described in terms of a particular cation or anion, e.g., arsenic, barium, or calcium.

d. **Microbiological Quality**.

(1) The microbiological quality of drinking water indicates its potential for transmitting waterborne diseases. Microbiological examinations will reveal the quality of the raw water source and is an aid in deciding the treatment needed. Indicator organisms are used to show the presence of fecal contamination in a water supply. The most common organisms used as indicators of possible contamination are bacteria of the coliform group such as *Escherichia coli, Klebsiella pneumonia,* and *Enterobacter aerogenosa.* These organisms occur in large quantities in the intestines of warm-blooded animals and are used as presumptive evidence of fecal contamination of water. Their occurrence, particularly in low densities, does not always mean that human fecal contamination has occurred. But, the presence of any coliform organism in treated drinking water is a sign of either inadequate treatment or the introduction of undesirable materials to the water after treatment.

(2) Microbiological examinations of potable water are conducted to show either the presence or absence of the coliform group. 40 CFR 141 discusses the EPA approved methods which include the membrane filter technique (MFT), multiple tube fermentation (MTF) technique, the Minimal Medium ONPG-MUG (MMO-MUG) test which includes Colilert®, and Colisure® and the presence-absence (P-A) coliform test.

(a) Membrane Filter Technique (MFT). Because of its relative simplicity, the MF has gained wide acceptance throughout the military. The MF, as described in the current edition of *Standard Methods for the Examination of Water and Wastewater*, may be used, unless another test is mandated by the state in which the public water system is located. A step-by-step description is included in Chapter 6 of this manual.

Unless other controls are specified by the applicable state, one positive (prepared with a rectal swab) and one negative control (sterile water or saline) should be run each month.

(b) Multiple Tube Fermentation Technique. The MTF is found in the current edition of *Standard Methods for the Examination of Water and Wastewater*. The MTF can be used when high amounts of suspended solids in the sample limit the use of the MFT.

(c) MMO-MUG test. The MMO-MUG Test is based on the ability of coliform bacteria to produce the enzyme beta-galactosidase which hydrolyses 0-nitropenyl-beta-d-glactopyranoside (ONPG) present in the chemically defined medium to form color. The formulation of the test medium suppresses the growth of non-coliform microorganisms; the target coliform microorganisms produce the color within 24 hours. Two commercial MMO-MUG test are currently available commercially, Colilert® and Colisure®. Directions for performing the MMO-MUG test are found on the package insert. If all positive total coliform tests are considered positive (without confirmation) for *E. coli* or fecal coliforms, control samples must be performed if required by the applicable state. If the state has no control requirements, positive (prepared with rectal swab) and negative (prepared with sterile water or saline) control samples must be accomplished at least monthly. When positive total coliform tests are confirmed as positive for *E. coli*/fecal coliforms the controls available from the manufacturer (Quanta Cult Kit in the case of IDEXX Laboratories Inc. for Colilert®) must be accomplished at least once for each lot number of the MMO-MUG material used.

(d) Presence-Absence (P-A) Coliform Test. The P-A Test is described in *Standard Methods for the Examination of Water and Wastewater*. It is a simple modification of the MTF procedure. Simplification is accomplished by the use of one large test portion (100 ml) in a single test tube. When the P-A is used, positive and negative controls should be accomplished on a monthly basis.

(e) The heterotrophic plate count (HPC) formerly the standard plate count is not required by NPDWR for bacteriological surveillance monitoring. Its use may be needed in water treatment plants in conjunction with modification of the turbidity limit. The HPC gives the number of bacteria that can grow under the conditions of the test. It has varying significance for finished water, particularly if the plating is not completed within six hours after collection of the sample. The test is valuable in finding the microbiological efficiency of the various units in a water treatment process. Excessively high counts may indicate serious contamination in the system and warrant further investigation.

(3) Other Microbiological Tests. Other methods exist to more specifically identify the origin of bacteriological contamination. Fecal coliform and fecal strep techniques are two commonly used methods. Specific testing procedures such as fecal coliform and fecal strep may be indicated for drinking water when more generalized testing (i.e., total coliform testing) yields positive results. Fecal coliform testing may be determined by using either the multiple tube or the membrane filter procedure. The membrane filter has been shown to have 93 percent accuracy for differentiating between coliforms from warm-blooded animals and coliforms from other sources. Fecal streptococcal group organisms can also be identified by using either membrane filter or multiple tube methods. The normal habitat of fecal streptococci is the intestines of man and animals, making these organisms one indicator of fecal pollution. Because of organism survival characteristics, other fecal indicators (fecal coliforms and total coliforms) must be used concurrently. Further discussion on the microbiology of drinking water and testing methods can be found in *Standard methods for the Examination of Water and Wastewater*. Consultation on this subject can be obtained by contacting the area Navy Environmental and Preventive Medicine Unit (NAVENPVNTMEDU).

e. Radiological Quality.

(1) Radiological water quality standards are based on the premise that any unnecessary exposure must be avoided. The physiological effects that are associated with overexposure to radiation demands the rejection of any treated water containing excess quantities of radionuclides. Proper treatment methods will provide drinking water of desired radiological quality in most cases. The NPDWR standards for radionuclide are summarized in Appendix E.

Section VIII MEETING THE REQUIREMENTS FOR WATER QUALITY SURVEILLANCE

5-30 WATER SYSTEMS NOT COVERED BY THE SAFE DRINKING WATER ACT

a. U.S. Navy and Marine Corps installations meeting all of the following criteria are not required to comply with the Safe Drinking Water Act, because they do not qualify as a Public Water System.

(1) The drinking water system consists of distribution and storage facilities only and the facility provides no treatment, including no re-chlorination or fluoridation anywhere in the system.

(2) Obtains all drinking water from a regulated water supplier.

(3) Does not sell drinking water.

(4) Does not provide water to commercial carriers conveying passengers in interstate commerce.

b. If a Navy or Marine Corps installation receives potable water from a neighboring town, provides no extra treatment of the water, and does not charge customers for the distributed water, the installation is exempt from compliance with federal drinking water regulations. However, some state and local drinking water regulations may apply, and Navy drinking water regulations apply.

5-31 WATER SYSTEM CLASSIFICATIONS

Public water systems are split in to two categories: Community water systems and non-community water systems. A community water system supplies water to year-round residents. A non-community water system supplies water to travelers or intermittent consumers. All non-community systems are further divided into two categories: Transient, non-community systems and non-transient, non-community systems. A transient non-community system could be a hotel or hospital that has its own water supply. The non-transient, non-community water system may be a school or work place with its own drinking water system that provides water for the same people throughout the year, but for less than 24 hours a day. The Safe Drinking Water Act applies to these different systems with different intensities, since consumer exposure to potential contaminants varies among the types of systems. The transient, non-community systems have only to comply with those regulations that govern contaminants (such as microbiological and nitrate/nitrite) which may result in acute health effects, rather than health effects associated with long-term exposure to contaminants (such as organic carcinogens). The non-transient, non-community systems must comply with all regulations that apply to community water systems with the exception of monitoring for trihalomethanes. As a general rule, if the Navy or Marine Corps owns and operates a water system and has a housing area, the system is a community water system. However, some remote range and testing facilities may be served by a non-transient, non-community system and some MWR camping facilities may be served by a non-transient, non-community system.

5-32 WATER QUALITY STANDARDS

Compliance with water quality standards of the SDWA, published in 40 CFR 141 as NPDWR (NSDWR 40 CFR 143, if enforced by the state), is determined in one of two ways: applying a required treatment technique to control or remove regulated contaminants, or providing water quality meeting all drinking water MCLs, ALs (in the case of lead and copper) and SMCL when required by the state. The MCL for a regulated chemical is a federally enforceable standard. Before establishing an MCL, the EPA considers the best available technologies for removing the contaminant, analytical technologies for monitoring the contaminant, and the cost of both. A balance is made between the cost to the consumer and the reduction of the risk to consumer health. This cost- benefit analysis attempts to achieve a risk to human health that is no greater than one in a million, e.g., the added threat of the contaminant at that level would cause no more than one extra cancer/adverse health effect per million people, each drinking two liters of water per day during a 70-year lifetime. Exceeding the AL level for lead or copper requires a water system to take action to reduce the leaching problem within the system and to educate and protect the consumer from exposure to lead and copper from drinking water. The EPA establishes each MCL upon the contaminant's MCLG (maximum contaminant level goal) which is the level of a contaminant in drinking water at which no known or anticipated adverse health effects are expected to occur. The MCLGs are not federally enforceable but are a more desirable limit.

5-33 STANDARDIZED MONITORING

a. Drinking water must be monitored to ensure that it meets all applicable MCLs. The EPA created a Standardized Monitoring Framework to reduce the variability and complexity of drinking water monitoring requirements. The framework synchronizes the monitoring schedule for source-related contaminants associated with the chronic health effects, e.g., volatile organic chemicals (VOCs), pesticides, herbicides, radionuclides, and inorganic other than nitrate/nitrite.

b. The Standardized Monitoring Framework. The framework consists of a nine-year compliance cycle which is comprised of 3-year compliance periods. The first nine-year compliance cycle began on 1 January 1993 and ends on 31 December 2001. The first three-year compliance period included 1993, 1994, and 1995. The framework provides states flexibility to determine the specific year within a compliance period that water systems must conduct monitoring activities. States may wish to prioritize sampling based upon system size, vulnerability, or laboratory capacity. Once a system is scheduled to sample in the first, second, or third year within a three-year compliance period, the system must then be sampled in the corresponding year of subsequent compliance periods.

c. Specific Standardized Monitoring Requirements.

(1) Each new set of regulations has initial sampling requirements that must be completed by all systems. The initial round of monitoring is required in the first full three-year compliance period after the effective date of a regulation. For

example, if a regulation was effective sometime in 1994, then initial monitoring must occur within 1996-1998.

(2) Systems that complete initial monitoring may be eligible to reduce monitoring frequency to the base or minimum sampling frequency. All systems must sample at this repeat frequency, unless they receive a waiver from the state.

(3) Systems that detect contamination, either during initial or repeat monitoring, must sample quarterly at each sampling point detecting contamination. The concentration that is considered "detection" is the MCL for organic chemicals, 0.0005 mg/L for VOCs, or the Method Detection Limit (MDL) for pesticides and herbicides, polychlorinated biphenyls (PCBs), and synthetic organic chemicals (SOCs). Quarterly sampling must continue until the state determines that the analytical results are "reliably and dependably" below the MCL. Ground-water systems must take a minimum of two quarterly samples before this decision can be made, and surface water systems must take four quarterly samples.

(4) Waivers are available to all systems based upon the results of a state conducted or approved vulnerability assessment. Waivers can either reduce sampling frequencies for VOCs and inorganics or eliminate sampling for pesticides, asbestos, and unregulated contaminants. Waivers based upon vulnerability assessments are good for three years for pesticides, six years for VOCs, and nine years for inorganic chemicals. A new vulnerability assessment must be performed to renew a waiver. Minimum criteria for the assessments are published in each regulation.

(5) The Standard Monitoring Framework allows for grandfathering monitoring data at the state's discretion. Data collected up to three years prior to the beginning of the three-year compliance period, in which initial monitoring is to begin, can be used to satisfy initial monitoring requirements. Systems grandfathering data would then monitor at the base monitoring frequencies unless issued a waiver.

5-34 VARIANCES AND EXEMPTIONS

a. The SDWA permits states to grant variance or exception to a PWS from an MCL if the state finds that doing so will not result in unreasonable risk to health or the consumers.

(1) The EPA provides guidance for states to use when

determining what constitutes an unreasonable risk to health when issuing variances and exceptions.

(2) The same guidance can be used to determine acceptable exposure levels in situations of temporary contamination of drinking water supplies.

(3) A draft document, *Guidance in Developing Health Criteria for Determining Unreasonable Risk to Health,* is available from the Safe Drinking Water Hotline. It gives health risk guidance for various regulated contaminants.

b. A variance is issued to a system when source water conditions prohibit a system from meeting an MCL, even with best available technology (BAT) application. A schedule for compliance with incremental progress toward achieving the MCL is issued at the same time the variance is issued. An exemption is granted to a PWS unable to comply with an MCL or treatment technique due to economic constraints. An exemption is granted for one year with the possibility for extending the reprieve for two additional years. Systems with 500 or less service connections may renew an exemption for one or more two-year periods upon demonstration of pursuit of all practical steps toward compliance. Not all regulations allow for variances and/or exemptions.

5-35 ANALYTICAL REQUIREMENTS

All regulated drinking water analyses must be conducted by state certified laboratories. All certified laboratories must conduct analyses using approved test methodologies. Federally approved methodologies are listed in 40 CFR 141 and 143.

5-36 LEAD CONTAMINATION CONTROL ACT AND LEAD AND COPPER RULE

a. The *Lead Contamination Control Act* was passed as an amendment to the SDWA in October 1988. It was designed to minimize children's exposure to lead from drinking water in schools and day care centers. A major provision of this Act required the EPA to publish a list of drinking water coolers that are not lead free. On 10 April 1989 this list was published in 54 FR 14320 and updated on 18 January 1990 in 55 FR 1772. The *Lead Contamination Control Act* also required states to provide a guidance document and testing protocol to assist schools to determine the source and amount of lead contamination in school drinking water and in controlling such contamination.

The EPA published a guidance document, *Lead in School Drinking Water - A Manual For School Officials to Detect, Reduce, or Eliminate Lead in School Drinking Water.*

b. Lead and Copper Rule. This rule was finalized in June 1991 with corrections/revisions in July 1991, June 1992, and June 1994. It is published in 40 CFR 141, Subpart I.

(1) Almost all lead and copper concentrations in water systems results from leaching of the metals from water service lines and internal plumbing materials rather than contaminated source water. Corrosive water allows leaching of lead and copper from the distribution system. The rule requires monitoring for lead and copper at the consumer's water tap (sink taps, not drinking fountains). Action levels (ALs) rather than MCLs were established for lead (0.015 mg/L) and copper (1.3 mg/L) in drinking water. First draw samples (water standing in the tap for at least six hours) are collected by catching the first water (one-liter) that comes from the tap and not allowing any flushing or wasting of the water. Action levels are not exceeded if 90 percent of the first draw samples fall below 0.015 mg/L for lead and 1.3 mg/L or for copper.

Table 5-5. Number of lead and copper samples required

Population Served	Standard Number of Samples	Reduced Number of Samples
>100,000	100	50
10,001 to 100,000	60	30
3,301 to 10,000	40	30
501 to 3,300	20	10
101 to 501	10	5
≤100	5	5

(2) Monitoring. The lead and copper rule has a monitoring schedule for large systems (serving more than 50,000 people), medium systems (serving 3,301 - 50,000 people), and small systems (3,300 or less people). Initial monitoring for the *Lead and Copper Rule* occurs for two consecutive six-month monitoring periods, although small and medium systems that exceed the action levels during the first six month monitoring period need not sample for a second six-month monitoring event. Schedules for continued monitoring depend upon the results

of the first two monitoring period. The *Lead and Copper Rule* requires water systems to monitor lead and copper content at the consumers taps within homes and work places. The number of samples required is determined by the number of people served by the system. See Table 5-5. The location of samples must be chosen according to specific criteria as defined by the rule. Targeted locations are divided into Tiers 1, 2, and 3. See Table 5-6. Water systems unable to get all required samples from Tier 1 sites must have the sample site plan approved by the state.

Table 5-6. Tier definitions

Tier	Sites Include
Tier 1	Single family structures* that: 1) Contain copper pipes with lead solder installed after 1982 or lead pipes 2) Served by lead service lines
Tier 2 **	Buildings or multi-family structures that: 1) Contain copper pipes with lead solder installed after 1982 or lead pipes 2) Served by a lead service line
Tier 3	Single family structures* that contain copper pipes with lead solder installed before 1983
* For community water systems whose area served consists of more than 20 percent multi-family residences, these structures may be included in the sampling pool. ** Non-transient, non-community water systems will consider Tier 2 as Tier 1 for the sampling pool. Tier 3 then becomes Tier 2.	

(3) Water Quality Parameters. Additional monitoring for distributed water quality characteristics (pH, alkalinity, orthophosphate, silica, calcium, conductivity, water temperature) must be conducted by all large systems. Small and medium systems must monitor water quality parameters when the

action levels for lead and copper are exceeded. See Table 5-7 for the number of water quality characteristic samples required.

(4) Guidance. The EPA published a detailed document, *Lead and Copper Rule Guidance Manual Volume I:* Monitoring, describing the steps involved in compliance monitoring which should be consulted when beginning to address the *Lead and Copper Rule.*

Table 5-7. Number of water quality samples required

Population Served	Standard Number of Samples	Reduced Number of Samples
≥ 100,000	25	10
10,001 to 100,000	10	7
3,301 to 10,000	3	3
501 to 3,300	2	2
101 to 501	1	1
≤ 100	1	1

(5) Treatment Techniques. Systems that exceed the lead and/or copper action level in either the initial six-month monitoring periods must begin corrosion control treatment. Guidance for corrosion control studies may be found in EPA manual, *Lead and Copper Rule Guidance Manual Volume II: Corrosion Control Treatment*.

(6) Reporting Requirements. Up to five basic elements may have to be reported to the state under the *Lead and Copper Rule:* tap water sampling results for both lead and copper and water quality parameters, source water monitoring results, treatment technique application results (corrosion control, source water treatment, and lead service line replacement), public education program demonstration, and results of any additional lead and copper or water quality samples taken by the system. Monitoring must be reported within the first ten days of the end of the monitoring period.

(7) Public Education Programs. The importance of public education programs is not just to remain in compliance with the *Lead and Copper Rule*, but to protect the health of the consumers. The rule has very specific required text and content

for a publication education program that is detailed in the rule. See *40 CFR -141, Subpart I*

5-37 SURFACE WATER TREATMENT RULE

a. Requirements of the *Surface Water Treatment Rule* (SWTR) are published in *40 CFR 141, Subpart H.* The SWTR applies to all PWS that use a surface water or ground-water source that is determined to be under the direct influence of surface water. The states have the responsibility to determine whether or not ground-water systems are under the direct influence of surface water and provide proper notification. Compliance with the rule can become very complex. EPA publication, *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface water Sources,* contains the exact regulatory requirements.

5-38 PUBLIC NOTIFICATION

a. Sometimes, the drinking water produced does not meet the criteria to be considered safe, as determined by regulations of the *Safe Drinking Water Act*. In these cases, the consumer must be notified of the concern and what he can do to protect himself. The EPA has established public notification criteria for all SDWA violations.

b. Since the regulations of the SDWA range from protection of health (compliance with MCLs and treatment techniques) to administrative requirements (monitoring at certain times, issue of variance exemptions, use of particular analytical techniques), the public notification requirements are divided into two tiers. Tier 1 violations may effect the health of the consumer and have more stringent requirements. These notifications must use certain verbiage called "mandatory health effects language." The language for each contaminant regulated by EPA is found in 40 CFR 141. Tier 2 violations are less serious and have less stringent public notification requirements.

c. General Content and Distribution of Public Notice. The EPA requires certain information to be included in all public notices, such as mandatory health effects language for Tier 1 violations, the phone number of a point of contact regarding the issue, and what the system is doing to correct the problem. The format of the notification must meet certain specifications, designed to be useful to the majority of the population served. The media type used and the frequency of distribution is also governed. EPA guidance manual, *General*

Public Notification for Public Water Systems, or *40 CFR 141, Subpart D* should be consulted when confronted with any public notification requirements.

5-39 SAFE DRINKING WATER ACT AMENDMENTS OF 1996

a. The Safe Drinking Water Act Amendments of 1996 (PL 104-182) establish a new charter for the nation's public water systems, states, and the EPA in protecting the safety of drinking water. The amendments include, among other things; new prevention approaches, improved consumer information, changes to improve the regulatory program, and funding for states and local water systems. The President signed the Amendments on August 6, 1996. Copies are available from the Government Printing Office (telephone number (202) 512-1808).

b. Consumer confidence Reports. Probably the first portion of the Safe Drinking Water Amendments of 1996 to impact on existing and new Navy and Marine corps community water systems is the requirements for consumer confidence Reports. Essentially this requires Navy and Marine corps owned community water systems to report to their consumers the number and types of contaminants that are in their drinking water, as well as other vital public health required quality information. The first report must be delivered to consumers by October 19, 1999, the second report by July 1, 2000 and subsequent reports by July 1 annually thereafter. Complete reporting requirements may be found in the Federal Register of August 19, 1998 (Volume 63, Number 160) page 44511-44536 and is available at <http://www.epa.gov/EPA-WATER/1998/August/Day-10/w22056.htm> on the internet. EPA is developing a computerized fill-in-the blank template that water systems will be able to use if they are unable or do not choose to develop their own consumer confidence report format. The American Waterworks Association 9AWWA) and the National Rural Water Association (NRWA) is preparing similar templates. Consumer Confidence Reports are required to include, but need not be limited to, the following information:

(1) The source of the water purveyed.

(2) A brief and plainly-worded definition of the terms maximum contaminant level goal, maximum contaminant level, variances, and exemptions.

(3) If any regulated contaminant is detected in the water purveyed by the community water system, a statement

setting forth: The maximum contaminant level goal; the maximum contaminant level; the level of such contaminant in the water system; and for any regulated contaminant for which there has been a violation of the maximum contaminant level during the year covered by the report, a brief statement in plain language regarding the health concerns that resulted in the regulation of that contaminant.

(4) Information on compliance with National Primary Drinking Water Regulations and a notice if the system is operating under a variance or exemption and the basis on which the variance or exemption was granted.

(5) Information on the levels of unregulated contaminants for which monitoring is required including Cryptosporidium and radon where states determine they may be found.

(6) A statement that the presence of contaminants in drinking water does not necessarily indicate that the drinking water poses a health risk and that more information about contaminants and potential health effects can be obtained by calling the Safe Drinking Water Hotline.

APPENDIX A

MODEL POTABLE WATER MONITORING PROGRAM FOR THE INSTALLATION PREVENTIVE MEDICINE AUTHORITY

A-1. Coordinate liaison with applicable federal, state, and local regulatory agencies for information and guidance with the medical monitoring program. The area NAVENPVNTMEDU can be a source of guidance on this subject.

A-2. Write a SOP detailing the potable water monitoring program to be followed by your branch or activity. Keep an updated list of all water resources.

A-3. Keep a current set of plans of the water distribution system.

A-4. Keep records of surveys, analyses, actions, and other information pertinent to the sanitary surveillance of the potable water system.

A-5. Keep copies of all regulatory agency and Navy/Marine Corps water regulations, instructions, and orders.

A-6. Collect samples for bacteriological analyses as directed, (e.g., after system or main disinfection, consumer complaints, special samples for studies in connection with positive EPA or state samples, monthly spot checks from points representative of the of major sections of the distribution system, etc.).

A-7. Perform chlorine residual tests to investigate water problems (e.g., taste and odor, consumer complaints, and with each above bacteriological analyses).

A-8. Review the results of all EPA or state potable water analyses conducted at certified water laboratories and local analyses performed in A-6 and A-7 above.

A-9. Inspect the water source, treatment plant (when located on the installation), and the storage and distribution system at least quarterly.

A-10. Approve or ensure that all chemicals additions and concentrations to potable water supplies are as listed in NSF

Standard No. 60. Also make sure that water tank coatings, potable water hoses, and other materials used in contact with potable water are listed in applicable NSF Standards.

A-11. Where applicable inspect the water treatment plant laboratory and review analytical procedures to assure compliance with *Standard Methods for the Examination of water and Wastewater*.

A-12. Set up a program to inspect for and eliminate cross-connections.

A-13. Coordinate with the facilities public works officer or maintenance officer to:

1. Provide feedback on inspections and analyses.

2. Ensure that the preventive medicine authority is notified when distribution system breakage, modification, flushing, shut-down, or when component or main disinfection occurs.

3. Ensure that adequate chlorine residuals are maintained (see 40 *CFR 141.72*). The disinfection must ensure at least 99.9 percent (3 log) inactivation of *Giardia lamblia* cysts and 99.99 percent (4 log) inactivation of viruses.

4. Develop contingency plans for natural or man-made disasters using a vulnerability analysis.

A-14. Pursue an aggressive continuing education program in health related potable water.

A-15. Provide applicable command environmental health guidance found in 0PNAV, NAVFAC, and BUMED instructions, Marine Corps Orders, appropriate state drinking water regulations, 40 CFR, and this publication.

APPENDIX B

DEFINITIONS

B-1. **AIRGAP** - A physical separation sufficient to prevent backflow between the free-flowing discharge end of a potable water system outlet and any other system. An air gap is physically defined as a distance equal to twice the diameter of the outlet but never less than one (1) inch.

B-2. **AQUIFER** - A permeable, water-bearing geologic formation.

B-3. **BACKFLOW** - The flow of water or other liquids, mixtures, or substances into the distribution pipes of a potable supply of water from any source or sources other than its intended source. Backsiphonage is one type of backflow.

B-4. **BACKFLOW PREVENTION DEVICE** - A device or means designed to prevent backflow or back siphonage. Most commonly categorized as air gap, reduced pressure principle device, double check valve assembly, pressure vacuum breaker, atmosphere vacuum breaker, residential dual check, double check with intermediate atmosphere vent, and barometric loop.

B-5. **BACKSIPHONAGE** - Backflow resulting from negative pressure in the distribution pipes of a potable water system.

B-6. **CHECK VALVE** - A self-closing device which is designed to allow the flow of fluids in one direction and to close if there is a reversal of flow.

B-7. **COMBINED AVAILABLE CHLORINE** - The chlorine products formed by the reaction of equilibrium products of ammonia with the equilibrium products of chlorine to form chloramines. Combined available chlorine has significantly less disinfecting power.

B-8. **COMMUNITY WATER SYSTEM** - A public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

B-9. **CONTAMINANT** - A substance that will impair the quality of the water to a degree that it creates a serious health hazard to the public leading to poisoning or the spread of disease.

B-10. **CROSSOVER POINT** - Any point or points where a potable water main makes contact or crosses over or under a non-potable liquid conduit (sewer, non-potable water supply, etc.

B-11. **CROSS CONNECTION** - Any actual or potential connection between the public water supply and a source of contamination or pollution.

B-12. **DISINFECTANT** - Any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic microorganisms.

B-13. **DISINFECTION** - A process which inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

B-14. **EPA** - The United States Environmental Protection Agency.

B-15. **FIELD WATER SUPPLY SYSTEM** - That assemblage of collection, purification, storage, transportation, and distribution equipment and personnel to provide potable water to field units in training and actual deployment environments.

B-16. **FILTRATION** - A process for removing particulate matter from water by passage through porous media.

B-17. **FINISHED WATER** - Treated water.

B-18. **FIRST DRAW SAMPLE** – A one-liter sample of tap water, collected in accordance with 40 CFR 141.86(b)(2), that has been standing in plumbing pipes at least six hours and is collected without flushing the tap.

B-19. **FIXED INSTALLATION** - An installation that, through extended use, has gained those structures and facilities not initially found or intended for use at a "temporary" facility, (e.g., paved roads, fixed electrical distribution systems, fixed water treatment facilities, and underground distribution lines).

B-20. **FLOOD LEVEL RIM** - The edge of the receptacle from which water overflows.

B-21. **FREE AVAILABLE CHLORINE** - Chlorine available (after chlorine demand has been satisfied) in the forms of hypochlorous acid and hypochlorite ions.

B-22. **GROUND WATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER** - Any water beneath the surface of the ground with: (1) significant occurrences of insects, microorganisms, algae, or large diameter pathogens such as *Giardia lamblia*, or; (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the state. The state determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation.

B-23. **HEALTH HAZARD** - Any condition, including any device or water treatment practice, that may create an adverse effect on a person's well-being.

B-24. **MARGINAL CHLORINATION** - Application of chlorine to produce the desired total chlorine residual without reference to the amounts of free or combined chlorine present.

B-25. **MAXIMUM CONTAMINANT LEVEL (MCL)** - The maximum permissible level of a contaminant in water which is delivered to any user of a public water system.

B-26. **MAXIMUM CONTAMINANT LEVEL GOAL (MCLG)** - The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are non-enforceable health goals.

B-27. **MEDICAL BACTERIOLOGICAL SAMPLING** - Independent bacteriological sampling, conducted by the preventive medicine authority, of the water distribution system to augment sampling required by NPDWR.

B-28. **NON-COMMUNITY WATER SYSTEM** - A public water system that is not a community water system.

B-29. **NON-POTABLE WATER** - Water that has not been examined, properly treated, or approved by proper authorities as being safe for domestic consumption. All waters are considered non-potable until declared potable.

B-30. **NON-TRANSIENT NON-COMMUNITY WATER SYSTEM (NTNCWS)** - Means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over six months per year.

B-31. **PALATABLE WATER** - Water that is pleasing to the taste and is significantly free from color, turbidity, and odor. Does not imply potability.

B-32. **POTABLE WATER** - Water that has been examined and treated to meet appropriate standards and declared fit for domestic consumption by responsible installation preventive medicine authorities.

B-33. **PREVENTIVE MEDICINE AUTHORITY (PMA).** The medical department representative(s) responsible for public health (preventive medicine). This will be the senior environmental health officer/preventive medicine technician for the area of responsibility. In their absence, Army Veterinary technicians, independent duty corpsmen, senior general duty corpsmen or medical officers may be designated.

B-34. **PRIMACY** - Primary enforcement authority. A state government has primary enforcement authority under the Safe Drinking Water Act. Primacy is delegated to the state by the EPA Administrator. Before assuming primacy, the state shall establish drinking water regulations no less stringent than the current NPDWR.

B-35. **PUBLIC WATER SYSTEM** - A system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system; and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is either a "community water system" or a "non-community water system."

B-36. **RAW WATER** - (1) Untreated water, usually the water entering the first treatment unit of a water treatment plant. (2) Water used as a source of water supply taken from an impounded body of water, such as a stream, lake, pond, or a ground water aquifer.

B-37. **REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER** - An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere designed to prevent backflow.

B-38. **SANITARY DEFECTS** - Conditions that may cause the contamination of a water supply during or after treatment. These include connections to unsafe water supplies, raw water bypasses in treatment plants, plumbing fixtures improperly designed and installed, and leaking water and sewer pipes in the same trench.

B-39. **SANITARY SURVEY** - An onsite review of the water source, facilities, equipment, operation and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

B-40. **SPRING** - A spring is a concentrated discharge of ground water appearing at the ground surface.

B-41. **STANDARD SAMPLE** - The aliquot of finished drinking water that is examined for the presence of coliform bacteria.

B-42. **SUPPLIER OF WATER** - Any person who owns or operates a public water system.

B-43. **TOTAL AVAILABLE CHLORINE** - The sum of the chlorine forms present as free available chlorine and combined available chlorine.

B-44. **TREATED WATER** - Water that has undergone processing such as sedimentation, filtration, softening, disinfection, etc., and is ready for consumption. Included is purchased potable water that is retreated (chlorinated, fluoridated, etc.).

B-45. **TOTAL TRIHALOMETHANES (TTHM)** - The sum of the concentration in milligrams per liter of the trihalomethane compounds (trichloromethane [choloroform], dibromochloromethane, bromodichloromethane,and tribromomethane [bromoform]) rounded to two significant figures.

B-46. **TRIHALOMETHANE (THM)** - One of the family of organic compounds, named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure.

B-47. **WATER QUALITY** - The chemical, physical, radiological, and microbiological characteristics of water with respect to its suitability for a particular purpose.

B-48. **VACUUM BREAKER, NONPRESSURE TYPE** - A device or means to prevent backflow designed not to be subjected to static line pressure.

B-49. **VACUUM BREAKER, PRESSURE TYPE** - A device or means to prevent backflow designed to operate under conditions of static line pressure.

B-50. **VULNERABILITY ASSESSMENT** – A systematic evaluation of a drinking water system's components to determine the critical points at which the system is vulnerable to natural and man-made disasters or terrorists activities, together with a list of recommendations to eliminate or decrease the vulnerability of the system to these threats.

APPENDIX C

PRINCIPAL WATERBORNE DISEASES OF CONCERN WITHIN CONUS

C-1. The principal diseases contracted by man from ingesting contaminated water are gastroenteritis, (both viral and bacterial), protozoal diseases, typhoid fever, salmonellosis, shigellosis, and viral hepatitis. Cryptosporidosis, and diarrhea caused by *Cyclospora protozoans* are emerging as major waterborne diseases. Common drinking water disinfectants are not effective against the infectious agent for cryptosporidosis, *Cryptosporidium parvum*, a protozooan.

C-2. *Cryptosporidium* gets into surface water sources such as rivers and lakes from the stools of infected animals. Many municipal water treatment plants get their water from these surface water sources that contain *Cryptosporidium* oocysts. Proper filtration techniques will usually remove *Cryptosporidium* oocysts. Chlorination by itself is not effective. The better the plant equipment and the more experienced the operators the less likely it is for oocysts to get through, but it is possible to have oocysts show up in drinking water that has been adequately treated. Health authorities believe that the detection of a few oocysts in drinking water does not pose a threat to people with healthy immune systems. Health officials determine if water is safe to drink by evaluating such things as changes in the source water, number of oocysts, turbidity, particle counts, presence of other organisms, water plant performance and maintenance records. If the water is unsafe officials will recommend bringing water to a rolling boil for one minute to kill all organisms including *Cryptosporidium*. Submicron, personal-use filter (home or office type water filters) may be used to remove *Cryptosporidium* oocysts. For this purpose those labeled as meeting NSF (NSF International) Standard No. 53 for cyst removal are recommended.

C-3. The transmission of waterborne diseases is not limited to water. They all enter man by the fecal-oral route. The impact of waterborne diseases may be catastrophic since a single contaminated water supply may affect an entire distribution system's population rather than isolated individuals. The incidence of waterborne outbreaks appears to be on the increase.

C-4. 40 CFR 141.72 now requires water systems to practice disinfectant treatment sufficient to ensure that the system achieve at least 99.9 percent (3 log) inactivation and/or removal of *Giardia lamblia* cysts and at least 99.99 percent (4 log) inactivation and/or removal of viruses, as determined by the state.

C-5. NAVMED P-5010-6 discusses disinfection of water manufactured on Navy ships both on the open sea and from areas where amebiasis or hepatitis is endemic. NAVMED P-5010-9 discusses water supply procedures for field units of the Navy and Marine Corps. NAVMED P-5038, *Control of Communicable Diseases Manual,* published by the American Public Health Association discusses the infectious agents, reservoirs, incubation periods, and methods of control for waterborne diseases found both in CONUS and in overseas areas.

APPENDIX D

NAVY ENVIRONMENTAL AND PREVENTIVE MEDICINE UNITS

UNIT	GEOGRAPHICAL AREA OF ASSIGNMENT
Officer in Charge Navy Environmental and Preventive Medicine Unit 2 1877 Powhatan Street Norfolk, VA 23511-3394 Commercial: (757) 444-7671 DSN: 564-7671 E-mail: epc0epu2@bumed30.med.navy.mil Web Site: www-nehc.med.navy.mil/nepmu2/	20^o W longitude West to 100^o W longitude, including Iceland
Officer in Charge Navy Environmental and Preventive Medicine Unit 5 3235 Albacore Alley San Diego, CA 92136-5199 Commercial: (619) 556-7070 DSN: 526-7070 E-mail: nepmu5@nepmu5.med.navy.mil Web Site: trout.nosc.mil/~nepmu5	100^o W longitude West to 150^o W longitude, including all of Alaska
Officer in Charge Navy Environmental and Preventive Medicine Unit 6 1215 North Road Pearl Harbor, HI, 96860-4477 Commercial: (808) 471-9505 E-mail: nepmu6@nepmu6.med.navy.mil Web Site: www-nehc.med.navy.mil/nepmu6/	150^o W longitude West to 70^o E longitude, except Alaska
Officer in Charge U. S. Navy environmental and Preventive Medicine Unit 7 PSC 824, Box 2760 FPO AE 09627-2760 Commercial: 011-39-95-56-4101 DSN: 624-4101 E-mail: sig1pmu@sig10.med.navy.mil Web Site: 204.34.200.10/	70^o E longitude West to 20^o W except Alaska

APPENDIX E

TREATED WATER QUALITY STANDARDS

Section 1. NATIONAL PRIMARY DRINKING WATER REGULATIONS (NPDWR)

E-1. Contaminant levels are presented in Tables E- through E-4.

Table E-1. Contaminant levels for inorganic chemicals

Contaminant	MCLG mg/L [1]	MCL mg/L	AL mg/L[2]
Asbestos	7 million fibers/L >10mm long	7 million fibers/L >10mm long	
Arsenic		0.05	
Barium	2	2	
Cadmium	0.005	0.005	
Chromium	0.1	0.1	
Copper	1.3		1.3 [3]
Lead	0		0.015 [4]
Mercury	0.002	0.002	
Nitrate (as N)	10	10	
Nitrite (as N)	1	1	
Total Nitrate and Nitrite (as N)	10	10	
Selenium	0.05	0.05	
Fluoride	4	4	

1 Maximum Contaminant Level Goal (MCLG). The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are non-enforceable health goals.

2 Action Level (AL). Concentrations of lead or copper in water that determine, in some cases, whether a water system must install corrosion control treatment, monitor source water, replace lead service lines, and undertake a public education program.

3 The copper action level is exceeded if the concentration of copper in more than ten percent of tap water samples properly collected during any monitoring period is greater than 1.3 mg/L (i.e., if the "90th percentile" copper level is greater than 1.3 mg/L).

4 The lead action level is exceeded if the concentration of lead in more than ten percent of tap water samples properly collected during any

monitoring period is greater than 0.015 mg/L (i.e., if the "90th percentile" lead level is greater than 0.015 mg/L).

Table E-2. Contaminant levels for volatile organic chemicals (VOCs)

Contaminant	MCLG mg/L	MCL mg/L
Benzene	0	0.005
Carbon tetrachloride	0	0.005
1,2-dichloroethane	0	0.005
1,1-Dichloroethylene	0.007	0.007
para-Dichlorobenzene	0.075	0.075
1,1,1-Trichloroethane	0.20	0.20
Trichloroethylene	0	0.005
Vinyl Chloride	0	0.002
o-Dichlorobenzene	0.6	0.6
cis-1,2-Dichloroethylene	0.07	0.07
trans-1-2-Dichloroethylene	0.1	0.1
1,2-Dichloropropane	0	0.005
Ethylbenzene	0.7	0.7
Monochlorobenzene	0.1	0.1
Styrene	0.1	0.1
Tetrachloroethylene	0	0.005
Toluene	1	1
Xylenes (total)	10	10

Table E-3. Contaminant levels for organic chemicals, pesticides, and PCBs

Contaminant	MCLG mg/L	MCL mg/L
Endrin	0.002	0.002
Lindane	0.0002	0.0002
Methoxychlor	0.04	0.04
Toxaphene	0	0.003
2,4-D	0.07	0.07
2,4-5-TP (Silvex)	0.05	0.05
Alachlor	0	0.002
Atrazine	0.003	0.003
Carbofuran	0.04	0.04
Chlordane	0	0.002
1,2-Dibromo-3-chloropropane (DBCP)	0	0.0002
Ethylene dibromide (EDB)	0	0.00005
Heptachlor	0	0.0004
Heptachlor epoxide	0	0.0002
Polychlorinated biphenyls (PCBs) (as decachlorbiphenyl)	0	0.0005
Aldicarb	0.001	0.003
Aldicarb sulfoxide	0.001	0.004
Aldicarb sulfone	0.001	0.002
Pentachlorophenol	0	0.001
Total Trihalomethanes (the sum of the concentrations of Bromodichloromethane, Dibromochloromethane, Tribromomethane (bromoform), and Trichloromethane (chloroform)		0.10 [1]

[1] The MCL for total trihalomethanes applies only to water systems serving 10,000 or more individuals and which add a disinfectant to the water. For systems serving less than 10,000 individuals, individual states, or the applicable DoD Environmental Final Governing Standards(in overseas locations) may adopt an effective date for the MCL.

E-2. Turbidity requirements vary. Details are found in the Surface Water Treatment Rule, 40 CFR 141, Subpart H. Turbidity requirements are summarized in Table E-4.

Table E-4. Turbidity MCLs

Filtration Type	Turbidity MCL
None	<5 NTU
Conventional *	0.5
Direct **	0.5
Slow Sand	1.01
Diatomaceous Earth	1.01
* Conventional Treatment consists of coagulation/flocculation, sedimentation, and filtration ** Direct filtration consists of addition of a filtration aid and filtration	

E-3. Coliform Bacteria

1. The MCL for coliform bacteria (also called total coliforms) is based on the presence or absence of coliforms in a sample rather than on an estimate of coliform density.

a. The MCL for systems analyzing at least 40 samples each month is: No more than five percent of the monthly samples may be total coliform positive.

b. The MCL for systems analyzing fewer than 40 samples/month is: No more than one sample per month may be total coliform positive.

2. A public water system must demonstrate compliance with the MCL for total coliforms each month it is required to monitor.

3. MCL violations must be reported to the state no later than the end of the next business day after the system learns of the violation.

4. Monitoring Requirements for Total Coliforms:

a. Each public water system must sample according to a written sample plan, as required by 40 CFR 141.21, Coliform Sampling plan. Plans are subject to state review and revision.

The state must establish a process which ensures the adequacy of the sample siting plan for each system.

b. A system must collect a set of repeat samples for each total coliform-positive routine sample and have it analyzed for total coliforms. At least one repeat sample must be from the same tap as the original total coliform-positive sample; other repeat samples must be collected from within five service connections of the original total coliform-positive sample. At least one must be upstream and another downstream. The system must collect all repeat samples within 24 hours of being notified of the original result, except where the state waives this requirement on a case-by-case basis. If a total coliform-positive sample is at the end of the distribution system, or one service connection away from the end of the distribution system, the state may waive the requirement to collect at least one repeat sample upstream of the original sampling site.

c. If total coliforms are detected in any repeat sample, the system must collect another set of repeat samples, as before, unless the MCL has been violated and the system has notified the state (in which case the state may reduce or eliminate the requirement to take the remaining samples).

d. If a system has only one service connection, the state has the discretion to allow the system to collect the required set of samples at the same tap over a four-day period or to collect a larger volume repeat sample(s) (e.g., a single 400 ml sample).

e. If a system which collects fewer than five samples/month detects total coliforms in any routine or repeat sample (and the sample is not invalidated by the state), it must collect a set of five routine samples the next month the system provides water to the public, except that the state may waive this requirement if (1) it performs a site visit to evaluate the contamination problem, or (2) it has determined why the sample was total coliform-positive and (a) this finding is documented in writing along with what action the system has taken or will take to correct this problem before the end of the next month the system serves water to the public, (b) this document is signed by the supervisor of the state official who makes the findings, (c) the documentation is made available to EPA and the public and (d) in certain cases (described in this rule), the system collects at least one additional sample.

f. Unfiltered surface water systems and systems using unfiltered ground water under the direct influence of surface water must analyze one coliform sample each day the turbidity of the source exceeds one National Turbidity Unit (NTU) (this sample counts toward the system's minimum monitoring requirements).

Table E-5. Total coliform sampling requirements

Population Served	Minimum Number of Routine Samples per Month
25 to 1,000	1*
1,001 to 2,500	2
2,501 to 3,300	3
3,301 to 4,100	4
4,101 to 4,900	5
4,901 to 5,800	6
5,801 to 6,700	7
6,701 to 7,600	8
7,601 to 8,500	9
8,501 to 12,900	10
12,901 to 17,200	15
17,201 to 21,500	20
21,501 to 25,500	25
25,001 to 33,000	30
33,001 to 41,000	40
41,001 to 50,000	50**

* For non-community water systems see NPDWR
** For community water systems serving greater than 50,000 see NPDWR

g. Monthly monitoring requirements are based on population served. Tables E-5 and E-6 summarize the routine and repeat sampling requirements for total coliforms.

5. Invalidation of Total Coliform Positive Samples

a. Each total coliform-positive sample counts in compliance calculations, unless it has been invalidated by the state. Invalidated samples do not count toward the minimum monitoring frequency.

b. A state may invalidate a sample only if:

(1) The analytical laboratory acknowledges that improper analysis caused the positive result;

(2) The system determines that the contamination is a domestic or non-distribution system plumbing problem on the basis that one or more repeat samples taken at the same tap as the original total coliform-positive sample is total coliform-positive, but all repeat samples at nearby locations are total coliform-negative; or

(3) The state has substantial grounds to believe that a total coliform-positive result is due to some circumstances or condition which does not reflect water quality in the distribution system if:

TABLE E-6. Monitoring requirements following a positive total coliform sample

<table>
<tr><td>No. Routine Samples/Month</td><td>No. Repeat Samples*</td><td>No. Routine Samples Next Month **</td><td rowspan="5">* Number of repeat samples in the same month for each total coliform-positive sample.

** Except where the state has invalidated the original routine sample, or where the state substitutes an on-site evaluation of the problem, or where the state waives the requirement on a case-by-case basis. See 40 CFR 141.21a(b)(5) for more details. Systems need not take additional samples beyond those normally required.

*** Systems need not take additional samples beyond those normally required.</td></tr>
<tr><td>1/Mo.</td><td>4</td><td>5/Mo.</td></tr>
<tr><td>2/Mo.</td><td>3</td><td>5/Mo.</td></tr>
<tr><td>4/Mo.</td><td>3</td><td>5/Mo.</td></tr>
<tr><td>5/Mo.</td><td>3</td><td>No additional required***</td></tr>
</table>

(a) The basis for this determination is documented in writing,

(b) This document is signed and approved by the supervisor of the state official who makes this determination, and

(c) The document is made available to EPA and the public.

TABLE E-7 Sanitary survey frequency for public water systems collecting fewer than five samples/month

System Type	Initial Survey Completed by	Frequency of subsequent Surveys
Community Water System	June 29, 1994	Every 5 years*
Non-Community Water System	June 29, 1994	Every 5 years*

*Annual on-site inspection of the system's watershed control program and reliability of disinfectant practice is also required by 40 CFR 141.71B for systems using unfiltered surface water or ground water under the direct influence of surface water. The annual on-site inspection, however, is not equivalent to the sanitary survey

6. Variances and exemptions are not allowed.

7. Sanitary Surveys. Periodic sanitary surveys are required for all systems collecting fewer than five samples per month, see Table E-7.

8. Fecal Coliforms/*E. coli.*

a. If any routine or repeat sample is total coliform-positive, the system must analyze the total coliform-positive culture to determine if fecal coliforms are present, except that the system may test for *E. coli* in lieu of fecal coliforms. If fecal coliforms or *E. coli* are detected, the system must notify the state before the end of the same business day, or if determined after the state office is closed, by the end of the next business day.

b. If any repeat sample is fecal coliform or *E. coli* positive, or if a fecal coliform or *E. coli* original sample is followed by a total coliform-positive repeat sample, and the original total coliform-positive sample or the repeat sample is not invalidated, the system is in violation of the MCL for total coliforms. This is an acute violation of the MCL for total coliforms.

c. The state has the option to allow a water system on a case-by-case basis, to forgo fecal coliform or *E. coli* testing on total coliform-positive samples if the system treats every total coliform-positive sample as if it contained fecal coliforms, i.e., the system complies with all requirements which apply when a sample is fecal coliform-positive.

d. State invalidation of a total coliform-positive sample invalidates subsequent fecal coliform or *E. coli* positive results on the same sample.

9. Heterotrophic Bacteria. Heterotrophic bacteria can interfere with total coliform analysis. Therefore, if the total coliform sample produces:

a. A turbid culture in the absence of gas production using the MTF;

b. A turbid culture in the absence of an acid reaction using the P-A;

c. or confluent growth or colony number that is "too numerous to count" using the MF; the sample is invalid (unless total coliforms are determined, in which case, the sample is valid) and the system must, within 24 hours of being notified of the results, collect another sample from the same location as the original sample and have it analyzed for total coliforms. In such case, EPA recommends using media less prone to interference from heterotrophic bacteria for analyzing the replacement sample. The state may waive the 24-hour time limit on a case-by-case basis.

10. Analytical Methodology

a. Total coliform analyses are conducted using the 10 tube MTF, the MF, The P-A or the MMO-MUG test. A system may also use the 5 tube MTF technique (using 20 ml sample portions) of a single culture bottle containing the MTF medium, as long as a 100 ml sample is used in the analysis.

b. A 100 ml standard sample volume must be used in analyzing for total coliforms, regardless of the analytical method used.

c. Fecal coliform analysis must be conducted using methods described in 40 CFR 141.21 and *Standard Methods*.

d. *E. coli* analysis must be conducted using methods described in the *Federal Register* of 8 Jan 91 (56 FR 642) and/or *Standard Methods*.

E-4. **The MCL for radiological contaminants* are:**

Gross alpha particle activity including Radium 226 but excluding radon and uranium	15 pCi/L
Combined radium-226 and radium-228	5 pCi/L
Tritium	20,000 pCi/L
Strontium-90	8 pCi/L

* Screening indicators have been established for radiological contaminants. Gross alpha present at less than or equal to 5 pCi/L, as an indicator, eliminates the need to analyze for radium 226 and 228. Gross beta present at less than or equal to 8 pCi/L, as an indicator, eliminates the need to analyze for tritium and strontium-90.

E-5. **Sodium.** Although sodium does not have an MCL, its concentration in drinking water can cause serious health effects for those consumers with special dietary needs (e.g., low sodium diet). All community water systems using surface water must analyze the water entering the distribution system for sodium annually. All community water systems using only ground water must analyze for sodium every three years. One sample must be collected per water plant or well upon entry to the distribution system. The results must be reported to the state and to the appropriate local and state public health officials. Some states may regulate the amount of sodium in public drinking water supplies to protect consumer health.

E-6. **Corrosivity.** The corrosivity of distributed water greatly influences the leaching of materials within the distribution system. The leached metals increase the levels reaching the consumer. All community water systems must monitor the water entering the distribution system for corrosivity characteristics at least one time. Two samples per water plant for surface water sources must be collected, one in the winter and one in summer. Ground water systems must take at least one sample per plant, or may, at the state's discretion take one sample if all plants (wells) draw from the same aquifer. Determination of the corrosivity of the water includes measurement of pH, calcium hardness, alkalinity, temperature, total dissolved solids, and calculation of indicators such as the Langelier Saturation Index, Ryznar Index, and Enslow Stability Indicator to adjust the pH and alkalinity of water so that a thin coating is maintained on the inside of piping and prevent corrosion. States may also require monitoring for parameters associated with increased corrosivity of water, such as sulfates and chlorides.

E-7. Special Regulations and Monitoring Requirements for Unregulated Contaminants. (40 CFR 141.40)

1. According to both Phase I and Phase II rules community and non-transient non-community water systems should have completed the required monitoring for unregulated contaminants. Table E-8 is the total list of unregulated contaminants as revised by the Phase V Rule.

2. Monitoring for Phase I unregulated contaminants required four consecutive quarterly samples for surface water sources and one sample at each entry to the distribution system for ground water sources (all systems should have initiated monitoring no later than 1 JAN 1991).

3. Monitoring for Phase II unregulated contaminants consisted of four consecutive quarterly samples for organic contaminants and one sample at each entry to the distribution system, regardless of the source. Initial monitoring for Phase II unregulated chemicals contaminants should have been completed by 31 DEC 1995. Repeat monitoring must be completed every five years. Small systems (<150 service connections) have the option to submit a letter of system availability for sampling to the state in lieu of collecting samples. Other systems may apply for waivers from the state.

Table E-8. Unregulated contaminant list

Phase I Organics	Monitored at State's Discretion	Phase II Organics
(1) Chloroform	(1) 1,2,4-Trimethylbenzene	(1) Aldicarb
(2) Bromodichloromethane	(2) 1,2,3,-Trichlorobenzene	(2) Aldicarb Sulfone
(3) Chlorodibromomethane	(3) n-Propylbenzene	(3) Aldicarb Sulfoxide
(4) Bromoform	(4) n-Butylbenzene	(4) Aldrin
(5) Dibromomethane	(5) Naphthalene	(5) Butachlor
(6) m-Dichlorobenzene	(6) Hexachlorobutadiene	(6) Carbaryl
(7) 1,1-Dichloropropene	(7) 1,3,5-Trimethylbenzene	(7) Dicamba
(8) 1,1-Dichloroethane	(8) p-Isopropyltoluene	(8) Dieldrin
(9) 1,1,2,2,-Tetrachloroethane	(9) Isopropylbenzene	(9) 3-Hydroxycarbofuran
(10) 1,3-Dichloropropane	(10) Tert-butylbenzene	(10) Methomyl
(11) Chloromethane	(11) Sec-butylbenzene	(11) Metolachlor
(12) Bromomethane	(12) Fluorotrichloromethane	(12) Metribuzin
(13) 1,2,3,-Trichloropropane	(13) Dichlorodifluoro-methane	(13) Propachlor
(14) 1,1,1,2-Tetrachloroethane	(14) Bromochloromethane	**Inorganics**
(15) Chloroethane		(1) Sulfate
(16) 2,2-Dichloropropane		
(17) o-Chlorotoluene		
(18) p-Chlorotoluene		
(19) Bromobenzene		
(20) 1,3-dichloropropene		

Section II. NATIONAL SECONDARY DRINKING WATER REGULATIONS (NSDWR)

E-9. Secondary MCLs

Contaminant	Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 color units
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/L
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5 to 8.5
Silver	0.1 mg/L
Sulfate	250 mg/L
Total Dissolved Solids (TDS)	500 mg/L
Zinc	5 mg/L

Note: The contaminants covered by this regulation are those that may adversely affect the aesthetic quality of the drinking water. These secondary levels represent reasonable goals for drinking water quality, but are not federally enforceable. The individual states may establish higher, lower or no levels for these contaminants. All Navy and Marine Corps facilities must provide drinking water of the highest quality in consonance with the NSDWR as well as the federally enforceable NPDWR.

APPENDIX F

MICROBIOLOGICAL SAMPLING TECHNIQUE FOR DRINKING WATER

F-1. Sample Size: For most purposes, a 100 to 120 ml sample will suffice. Prior coordination with the testing facility is recommended.

F-2. Container: A sterile, clean container with a screw cap will be used for microbiological water sampling. Environmental Protection Agency approved bags containing sodium thiosulfate may also be used.

F-3. Procedure:

1. Open the cold water tap and allow the water to flow freely for two to three minutes to ensure drawing water directly from the main. Reduce the flow to produce a small stream of water. Determine the chlorine (bromine if at sea) residual and pH, and record the values on DD Form 686. Samples must not be collected from faucets with aerators, swivel or add-on devices unless these devices are removed before the step of running the water.

2. Carefully remove the cap or stopper of the sample bottle by grasping the outside of the cap. Do not touch any surfaces which the sample will contact. Hold the cap in one hand and fill the bottle to within 1/2 inch (2.5 cm) of the top and replace the cap. This air space is necessary to facilitate mixing by shaking before examination.

3. Complete the information on DD Form 686 (Bacterio-logical Examination of Water) identifying the sample as to exact source, time of collection, halogen residual, special circumstances, if any, and the address to which the report will be forwarded. Identify the sample bottle and the data card by the same number.

4. Sodium thiosulfate should be added to the sample container before collecting the sample. This chemical stops bacteriocidal action of the chlorine (bromine) residual present in the drinking water sample. Consult the current edition of *Standard Methods for the Examination of Water and Waste Water* for preparation of this chemical. **Do not rinse or flush the sample container during or prior to collecting the sample as the sodium thiosulfate will be washed out!**

F-4. Unless refrigerated, water samples must be processed within one hour of collection. In the case of potable water samples sent to the laboratory by courier, the samples must be transported in an ice cooler during transport to the laboratory, refrigerated upon receipt at the laboratory, and be processed within two hours. If local conditions necessitate delays longer than six hours, consider either making field examinations or using delayed-incubation procedures. The requirements may not be realistic when shipping samples; however, the time between collecting and examination should not exceed 24 hours. Where refrigeration of shipped samples is not possible, a sterilized thermos-type insulated container may be used. Record the time and temperature of storage on all samples and consider that information with interpretation of the data.

F-5. Flaming water taps before collecting potable water samples is not necessary if reasonable care is exercised in the choice of sampling tap (clean, free of attachments, and in good repair)and if the water is allowed to flow at a uniform rate before sampling. Alterations in the valve setting to change the flow rate during collection could affect the sample quality. Superficially passing a flame from a match or an alcohol soaked cotton applicator over the tap a few times may have a psychological effect on observers, but it will not have a lethal effect on attached bacteria. The application of intense heat may damage the valve-washer seating or create a fire hazard to combustible materials near the tap. If successive samples from the same tap continue to show coliforms, the tap may be disinfected with a hypochlorite solution to reduce external contamination as a source of these organisms.

APPENDIX G

REMEDIAL ACTIONS TO BE TAKEN IN THE EVENT CONTAMINATED WATER SAMPLES ARE FOUND

CONDITIONS	POSSIBLE CAUSE	RECOMMENDATIONS
1. No known sanitary defects, health hazards, or incidents of a gastrointestinal disease.	The contaminated samples might indicate a localized situation within the piping of the building where the sample was collected, or a faulty sampling technique.	a. Collect repeat samples promptly (see Appendix F). b. Expedite shipment of samples so that prompt report may be obtained from the laboratory. c. Make an immediate investigation to determine if any unusual conditions have occurred, such as repairs to water mains, faucets, or piping within the building, or in the vicinity of the sampling point. d. Test for chlorine at various outlets to ensure the proper dosage e. If the foregoing investigation shows the need, flush the portion of the system by opening outlets, until a proper chlorine residual is recorded; carry out localized chlorination if needed. f. Re-sample following the procedures outlined in Appendix E. g. If examination shows that conditions defined in Paragraph 2 below exist, then the remedial actions in that paragraph must be followed.

CONDITIONS	POSSIBLE CAUSE	RECOMMENDATIONS
2. Occurrence of a major disaster, such as the inundation of the source, breakdown in treatment units, gross contamination of the system through a cross-connection, failure of an underwater crossing, damage from an earthquake, etc.	Self evident.	a. Immediate rejection of water supply system and institution of an emergency treatment program. Treat all drinking water and water used for culinary purposes. b. After the necessary repairs have been completed, super-chlorinate and flush the entire system. c. Collect samples from representative points throughout the system until negative microbiological results are obtained on at least two consecutive sets of standard samples collected on different days. d. Remove restrictions on the use of water.
3. Occurrence of an outbreak of one of the so-called waterborne diseases.	Contamination of the water at the source, in reservoirs, treatment plant facilities, or distribution system and not generally obvious at the onset of the outbreak.	a. Carry out recommendations under condition 1 with special emphasis on the investigation of the source, reservoirs, treatment processes, and distribution system. b. Increase the chlorine dosage and residual in the system. c. If the conditions contributing to contamination are found to be serious, such as direct contamination by sewage, reject the supply and institute emergency treatment until the condition is corrected.

APPENDIX H

REFERENCES

H-1. **Navy Instructions.**

1. OPNAVINST 5090.1B, Environmental and Natural Resources Protection Manual

2. NAVFACINST 11330.llE, Backflow Preventers, Reduced Pressure Principle Type

3. BUMEDINST 6240.10, Standards for Potable Water

H-2. **Marine Corps Orders.**

1, MCO 5090.2A, Environmental Compliance and Protection Manual

H-3. **Naval Facilities Engineering Command Manuals.**

1. DM-03-01 Plumbing Systems

2. MIL-HDBK-1005/7 Water Supply Systems

3. NAVFAC MO-210, Maintenance and Operation of Water supply, Treatment and Distribution Systems (0525-LT-173-1950)

H-4. **U. S. Environmental Protection Agency Publications.**

1. *Guidance in Developing Health Criteria for Determining Unreasonable Risk to Health*. Draft document available from EPA Hotline

2. *Developing a State Wellhead Protection Program, A User's Guide to Assist State Agencies Under the Safe Drinking Water Act*

3. *Lead and Copper Rule Guidance Manual Volume I: Monitoring*

4. *Lead and Copper Rule Guidance Manual Volume II, Corrosion Control Treatment*

5. *Cross Connection Control Manual*, EPA No 570-89-007

6. *Water on Tap: A consumer's Guide to the Nation's Drinking Water*, EPA No. 815-K-97-002

H-5*.* **American Water Works Association Publications***.*

1. *AWWA Standard for Water Wells*, ANSI/AWWA A100-90

2. *AWWA Standard for Disinfecting Water Mains*, ANSI/AWWA C651-92

3. *AWWA Standard for Water Wells*, ANSI/AWWA A100-90

H-6. **Public Law.**

1. Public Law 93-532, The Safe Drinking Water Act 1974 and amendments of 1977, 79, 80, 86, and 96

H-7. **Code of Federal Regulations.**

1. Title, 29 Code of Federal Regulations, Part 1910, OSHA Safety and Health Standards (29 CFR 1910)

2. Title 40, Code of Federal Regulations, Part 141, National Primary Drinking Water Regulations, (40 CFR 141)

3. Title 40, Code of Federal Regulations, Part 142, National Primary Drinking Water Regulations Implementation (40 CFR 142)

4. Title 40, Code of Federal Regulations Part 143, National Secondary Drinking Water Regulations (40 CFR 143)

H-8. **U.S. Army Publications.**

1. Guidance For Providing Safe Drinking Water at Army Installations, USACHPPM Technical Guide No. 179

2, Technical bulletin Medical (TB MED) 576, Sanitary Control and Surveillance of Installation Drinking Water Supplies

H-9. **Miscellaneous**

1. *Standard Methods for the Examination of Water and Wastewater,* 19th Ed, AWWA, WEF, APHA

2. Environmental Engineering and Sanitation, 4th ed, Salvato, J.A. John Wiley and Sons

3. Handbook of Chlorination and Alternative Disinfectants 3rd ed. White, G.C.